# ECE 3600 Exam 1   given: Fall 08   (The space between problems has been removed.)

Write Legibly!   This part of the exam is Closed book, Closed notes, No Calculator.

(41 pts) Questions   If I can't read what you've written or you answer is ambiguous, I'll assume you don't know.

1. Electric Utilities have been forced to break up into two separate companies responsible for:
   a.   b.

2. Give the two largest sources of energy used to produce electricity in the US. List the largest first.
   1.   2.

3. The Gadsby power plant (which we visited) uses what source of energy?

4. Give the approximate efficiency of a Rankin-cycle steam turbine power plant, regardless of the source of heat.

5. a) Why can't a wind turbine's coefficient of performance be 100%?

   b) What two things can be controlled to maximize the coefficient of performance?

6. Some power sources are used to supply base loads and some are used to supply peak loads.
   a) What is a "base load".

   b) What is a "peak load".

   c) The Gadsby power plant (which we visited) is used to supply what type of load?

7. a) _____ is the letter used for Magnetic Flux Density

   b) _____ is the letter used for Magnetic Field Intensity

   c) _____ is the letter used for Magnetic Permeability

   d) How are these three things related to one another (give an equation)?

   e) Name the common magnetic curve shown at right.

   f) Label the axes on the figure shown at right.

8. List the 4 common long-distance high-voltage transmission line voltages given in your text.

9. What is bundling?

10. What insulates the wires from one another in an overhead transmission line?

11. A type of wire used in transmission lines has a steel core. What is it called (name or abbreviation)?

12   What is special about a transmission line that is loaded at 1 SIL?
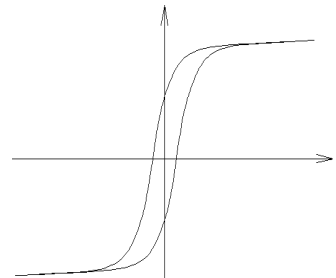
The following problems were handed out to the student after finishing the closed-book part.

This part of the exam is open book, open notes. You <u>MUST</u> show work to get credit.   Show the correct units
for each value. Assume $f := 60 \cdot Hz$ for all problems and normal abc sequence for all 3ϕ

1. (20 pts) R_L, & C_L together are the load in the circuit   Single-phase, like lab 1
   shown. The voltmeter measures $180\ V$, the ammeter
   measures $10\ A$, and the wattmeter measures $1440\ W$.
   Find the following:
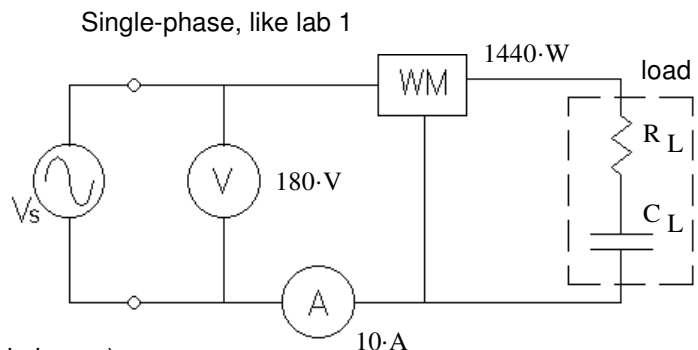
   a) The value of the load resistor. R_L = ?

   b) The apparent power. $|S|$ = ?

   c) The complex power. S = ?

   d) The power factor. pf = ?

   e) The power factor is: i) leading   ii) lagging   (circle one)

   f) The two components of the load are in a box which cannot be opened. Add (draw it) another component
      to the circuit above which can correct the power factor (make pf = 1). Show the correct component in the
      correct place and <u>find its value</u>. This component should not affect the real power consumption of the load.

2 (10 pts) Three impedances of $Z_{Load} = |Z_{Load}| \underline{/-20^\circ}$ are Y-connected to 3-phase lines.
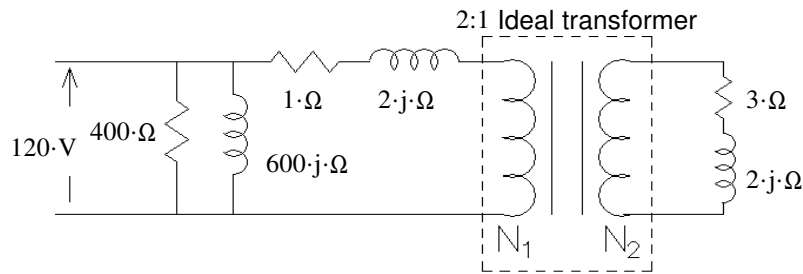
$$\arg(Z_{Load}) = -20 \cdot \deg$$

a) What is the phase angle between I_A and V_{AB} ? Hint: a drawing of phasors will be very helpful.

b) Circle one I_A leads V_{AB} I_A lags V_{AB}

c) If the same load were connected in Δ, how does that change the phase angle between I_A and V_{AB} ?

3. (19 pts) Find the following:

a) The line current that would be measured by an ammeter.

b) The power consumed by the three-phase load.

c) The value of Y-connected impedances that would
result in exactly the same line currents and same pf.

$Z_Y = ?$

d) The value of Y-connected capacitors that would correct the pf.

480·V
3ϕ source

All $Z := (30 + 12 \cdot j) \cdot \Omega$
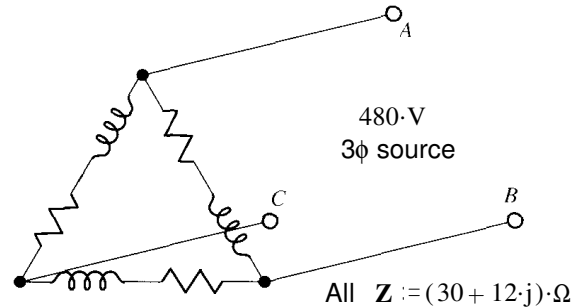
Exam 1, problem 4 is N/A so this is Exam 2, problem 2   given: Fall 08

2. (12 pts) A model of a $2{:}1$ step-down transformer is shown below. The transformer is loaded with $Z_L := (4 + 2 \cdot j) \cdot \Omega$.
Find the power efficiency, η.

2:1 Ideal transformer

$120 \cdot V$ $400 \cdot \Omega$ $1 \cdot \Omega$ $2 \cdot j \cdot \Omega$ $3 \cdot \Omega$

$600 \cdot j \cdot \Omega$ $2 \cdot j \cdot \Omega$
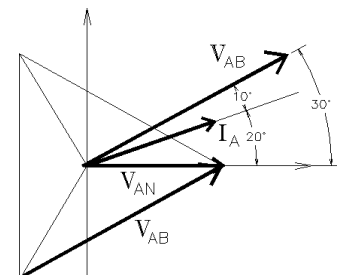
N_1 N_2

Answers
Closed-book part
1. a. Generation   b. Transmission/distribution

2. 1. Coal   2. Nuclear   3. Natural Gas (partial credit if listed as #2)

3. Natural Gas   4. 35 - 40%

5. a) Can' t stop the wind entirely or the air won' t get out of the way.   b) Blade pitch angle and rotational speed

6. a) The electrical load which nearly constant.

b) The electrical load above the base load which fluctuates from hour to hour.   c) peak

7. a) B   b) μ   c) H   d) B = μ·H   e) B-H curve or Hysteresis curve   f) x-axis: H   y-axis:

8. 115·kV   230·kV   345·kV   500·kV   765·kV   4 of these   9. Multiple wires per phase

10. Air (and distance)   11. ACSR,   **A**luminum **C**onductor, **S**teel **R**einforced

12   The transmission line VARS = 0. It doesn' t change the pf. $V_S = V_R$ if R = 0

Open-book part

1. a) $14.4 \cdot \Omega$ b) $1.8 \cdot kVA$;c) $(1.44 - 1.08 \cdot j) \cdot kVA$ d) 0.8   e) i) leading, because the load is capacitive

f) Add an inductor in parallel with load $79.6 \cdot mH$ 2. a) I_A lags V_{AB} by 10°

b) I_A lags V_{AB}

3. a) $25.7 \cdot A$ b) $19.9 \cdot kW$

c) $(10 + 4 \cdot j) \cdot \Omega$ d) $91.5 \cdot \mu F$

c) No change

Exam 2, Problem 2   89%

V_{AB}
10° 30°
I_A 20°
V_{AN}
V_{AB}